

# Four new species of the genus *Ochyrocera* (Araneae, Ochyroceratidae) from iron caves of the state of Minas Gerais, with the description of the third anophthalmic species from Brazil

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Academic editor: Martina Pavlek | Received 11 August 2021 | Accepted 2 December 2021 | Published 10 December 2021

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<http://zoobank.org/DFFC1757-EE7B-41F4-88DB-A495EBC9E54E>

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**Citation:** Brescovit AD, Zampaulo RdeA, Pedroso LM, Cizauskas I (2021) Four new species of the genus *Ochyrocera* (Araneae, Ochyroceratidae) from iron caves of the state of Minas Gerais, with the description of the third anophthalmic species from Brazil. Subterranean Biology 41: 43–68. <https://doi.org/10.3897/subtbiol.41.72895>

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## Abstract

Four new species of the spider genus *Ochyrocera* Fage, 1912 are described from iron caves in the state of Minas Gerais, Brazil. Here we present the third anophthalmic and depigmented species of the genus, *O. dorinha* **sp. nov.**, and three other depigmented species: *O. monica* **sp. nov.**, *O. magali* **sp. nov.** and *O. rosinha* **sp. nov.** Only *O. dorinha* **sp. nov.** and *O. rosinha* **sp. nov.** are considered as troglobites due the ocular reduction or anophthalmia and elongated appendages, two troglomorphic features absent in the other species described.

## Keywords

Brazilian Southeast Region, endemic, subterranean spiders, Synspermiata, taxonomy, troglobite

## Introduction

The known diversity of the spider family Ochyroceratidae in Brazil has recently increased by a relevant number of species from caves (Baptista et al. 2008; Brescovit et al. 2018; Brescovit and Cizauskas 2018; Brescovit et al. 2021). There are 16 species of *Ochyrocera* in Brazil (World Spider Catalog 2021), nine of which are from ferruginous caves in the state of Pará (Brescovit et al. 2018; Brescovit et al. 2021), two from caves in the state of Minas Gerais (Baptista et al. 2008; Brescovit and Cizauskas 2018), and the remaining five are epigean.

Among the diversity in caves of the state of Minas Gerais, *Ochyrocera ibitipoca* Baptista, González & Tourinho, 2008 was described from a pseudo-karstic area composed of quartzite rocks in the region of Parque Estadual do Ibitipoca, in the south of the state (Baptista et al. 2008). *Ochyrocera brumadinho* Brescovit & Cizauskas, 2018, was found only in ferruginous caves in the municipality of Brumadinho in the region of the Quadrilátero Ferrífero (Iron Quadrangle) (Brescovit et al. 2021). Both species do not present any troglomorphism and share an accentuated olive-green color and six very characteristic eyes.

When reviewing specimens of Ochyroceratidae recently collected in iron caves of the state of Minas Gerais, we detected four new species with strong depigmentation of the body. We also found one of them to be an anophthalmic species, expanding the number of anophthalmic species of *Ochyrocera* to three, together with *Ochyrocera ritxoco* Brescovit, Zampaulo & Cizauskas, 2021 and *O. ritxoo* Brescovit, Zampaulo & Cizauskas, 2021, which are considered troglomorphic (Brescovit et al. 2021). In this work, we describe four new species of the genus *Ochyrocera*, all collected in ferruginous caves located in the Southern Serra do Espinhaço (Espinhaço Mountain Range) and/or in the Quadrilátero Ferrífero in the state of Minas Gerais in Southeast Brazil.

## Materials and methods

### Study area

The four species described in this work are associated with caves inserted in the iron formations of two important regions of the state of Minas Gerais, the Quadrilátero Ferrífero and Serra do Espinhaço. Both regions comprise a large mosaic of phytophysionomies shaped by the conjunction of topography, lithology, climate, and altitude (Jacobi and Carmo 2008) and are inserted in a transition zone between two Brazilian biodiversity hotspots, the Atlantic Forest and the Cerrado biomes (Mittermeier et al. 2004). In general, the climate in these regions is characterized as Cwb (High altitude subtropical climate), with mild and humid summers, and cool and dry winters (Köppen 1948), but it can be strongly influenced by the relief since the average altitude exceeds a thousand meters with the highest regions reaching two thousand meters. The annual precipitation varies between 1,250 and 1,550 mm and the average annual temperature between 18 °C and 19 °C.

Serra do Espinhaço comprises a chain of mountains about a thousand kilometers in length that extends from the north of the state of Bahia to the south center of the state of Minas Gerais, close to the Quadrilátero Ferrífero (Fig. 14). An important mining region since the colonial period, mainly due to the extraction of diamonds or gold, Serra do Espinhaço has been considered a World Biosphere Reserve since 2005, as it is one of the richest regions on the planet in terms of natural resources (UNESCO 2011). This mountain range also represents a major hydrographic divide in Southeast Brazil between the basins of the São Francisco River to the west, and the rivers that flow into the Atlantic Ocean to the east (Derby 1906; Saadi 1995). The species herein described from this region is found in the southern portion of the Southern Serra do Espinhaço (Fig. 14), where more than a thousand caves have been registered (CECAV 2021).

In turn, the Quadrilátero Ferrífero has an area of approximately 7,200km<sup>2</sup> and is considered one of the most important mineral provinces in Brazil, mainly due to its gold and iron deposits. At the same time, the region is one of the most floristically diverse areas in South America with high rates of endemism (Harley 1995; Giuliatti et al. 1997). The area is considered to be of special biological relevance due to the presence of ferruginous fields, the occurrence of endemic plant species to the region, and because it constitutes a unique environment in the state. Formed by ancient and geologically complex terrains of the Minas Super Group, with varied lithologies (Alkmim and Marshak 1998; Klein and Ladeira 2000), more than two thousand caves are currently known in the region (CECAV 2021) and dozens of cave species have been discovered and described in recent years.

## Taxonomic descriptions

The specimens were deposited in the Brazilian collections of the Instituto Butantan, São Paulo (IBSP, curator A.D. Brescovit), Coleção de Invertebrados Subterrâneos do Laboratório de Ecologia Subterrânea, Universidade Federal de Lavras (UFLA, curator R.L. Ferreira), and Centro de Coleções Taxonômicas, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil (UFMG, curator A.J. Santos).

Morphological terms follow Brescovit et al. (2018), except for macrosetae of endites, which follows Baert (2014). Descriptions and measurements were performed using a LEICA 165C stereomicroscope. Photographs were taken with a Leica DFC 500 digital camera on a Leica MZ16A stereomicroscope. Focal-range images were made using Leica Application Suite software, version 2.5.0. Total and femur lengths were measured in lateral view without detaching any part from the specimen. All measurements are in millimeters. Female genitalia were excised with a sharp needle, digested using one tablet of enzymatic eye lens cleaner (Ultrazyme enzymatic cleaner) into 5ml distilled water for 24 hours and photographs were taken using Hoyer's microscope slides. For scanning electron microscopy (SEM) images, body parts were dehydrated in a graded series of ethanol washes (80% to 100%), dried by critical point, mounted on metal stubs using adhesive copper tape and nail polish for fixation and covered with gold. SEM images were taken with a FEI Quanta 250 scanning electron microscope at Laboratório de Biologia Celular of Instituto Butantan, São Paulo, Brazil.

## Results

### Family Ochyroceratidae Fage, 1912

#### Genus *Ochyrocera* Simon, 1892

#### *Ochyrocera dorinha* Brescovit, Zampaulo, Pedroso & Cizauskas, sp. nov.

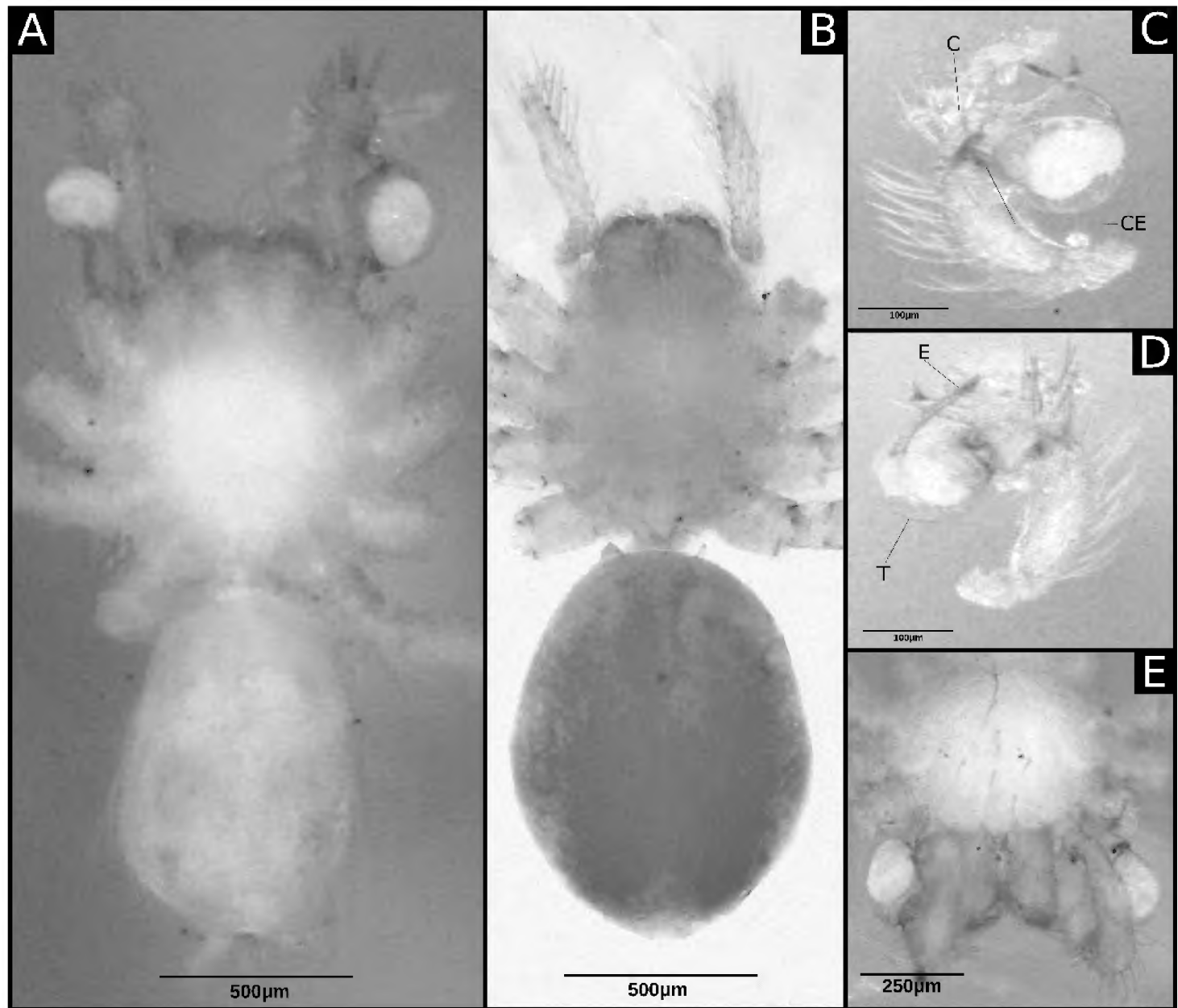
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Figures 1–5, 14, 15

**Type material.** *Holotype* 1♂ (IBSP 196428a), and paratype 1♀ (IBSP 196428b), BRAZIL, Minas Gerais, Quadrilátero Ferrífero, Itabirito, Cave MP\_0008 (20°12'40"S, 43°51'13"W), 29/III/2012, Equipe Carste col. *Paratypes*: 2♂, 3♀ (UFMG 25396), Brazil, Itabirito, Mina do Pico, Cave MP\_0011 (20°13'04"S, 43°51'26"W), 11/VI/2013, M.P.A. Oliveira col.

**Other material examined.** BRAZIL, Minas Gerais: 1♂ (IBSP 191074), Caeté, Serra da Piedade, Cave AVG\_0030 (19°49'21"S, 43°41'50"W), 18/V/2013, M.P.A. Oliveira col.; 1♂ (IBSP 195206), Itabirito, Mina do Pico, Cave MP\_0004 (20°13'23"S, 43°51'14"W), 05/IV/2013; 5♀ (IBSP 196426) & 1♂ 5♀ (IBSP 196427) both collected at Itabirito, Mina do Pico, Cave MP\_0008, 10/IV/2013, by M.P.A. Oliveira; 6♀ (IBSP 198873), 06/VI/2017; 1♂ (IBSP 198875), 06/VI/2017; 1♀ (IBSP 198877), 31/I/2017, all collected at Mina do Pico, Cave MP\_0008 by Ativo Ambiental; 2♂ (IBSP 196425), 09/IV/2013, M.P.A. Oliveira col.; 1♀ (IBSP 196429), 26/III/2012, Equipe Carste col., both collected at Mina do Pico, Cave MP\_0008; 1♀ (IBSP 198874), Itabirito, Cave MP\_0011 (20°13'03"S, 43°51'25"W) 08/VI/2017, Ativo Ambiental col.; 1♂ (IBSP 196433), Mariana, Cave GS\_0011, 27/III–04/IV/2012, I. Cizauskas col.; 1♀ (IBSP 196413), Mariana, Cave GS\_0025 (20°12'19"S, 43°29'58"W), 16/I–11/II/2011; 1♀ (IBSP 196419), Mariana, Cave GS\_0025, 06–16/VI/2011; 2♀ (IBSP 196415; IBSP 196420), Mariana, Cave GS\_0031 (20°12'32"S, 43°29'45"W), 16/I–11/II/2011; 2♀ (IBSP 196414), Mariana, Cave GS\_0031, 16/I–11/II/2011; 1♀ (IBSP 196416), Mariana, Cave GS\_0033 (20°12'31"S, 43°29'45"W), 06–16/VI/2011, all collected by R. Bessi & I. Cizauskas et. al.; 1♀ (IBSP 196418), Mariana, Cave GS\_0033, 06–16/VI/2011, R. Bessi & I. Cizauskas et. al.; 1♀ (IBSP 196417), Mariana, Cave GS\_0033, 06–16/VI/2011, R. Bessi & I. Cizauskas et. al.; 2♀ (IBSP 203317) & 2♂ (IBSP 203318), Mariana, Cave GS\_0033, 18/VI–10/VII/2019, Equipe Carste col.; 2♀ (IBSP 203323), Mariana, Cave GS\_0035 (20°12'33"S, 43°29'47"W), 18/VI–10/VII/2019, Equipe Carste col.; 2♀ (IBSP 264543), Mariana, Cave FN\_0003 (20°13'19.20"S, 43°26'2.76"W), 03–04/XII/2020, Equipe Spelayon et al col.; 1♀ (IBSP 189183), Mariana, Cave FN\_0005 (20°13'18"S, 43°26'3"W), 12/XII/2012, BioEspeleo Consultoria Ambiental col.; 1♀ (IBSP 184258); Mariana, Cave FN\_0027 (20°13'25"S, 43°26'15"W), 28/VI/2012, E.L. Borges & M.T.M. Souza col.; 1♂ (IBSP 189184), Mariana, Cave FN\_0027, 24/X/2012; 2♀ (IBSP 189185), Mariana, Cave FN\_0027, 12/XII/2012, all collected by BioEspeleo Consultoria Ambiental col.; 1♂ (IBSP 196431), Mariana, Cave FN\_0027, 03–07/II/2011, R. Andrade et. al. col.; 1♀

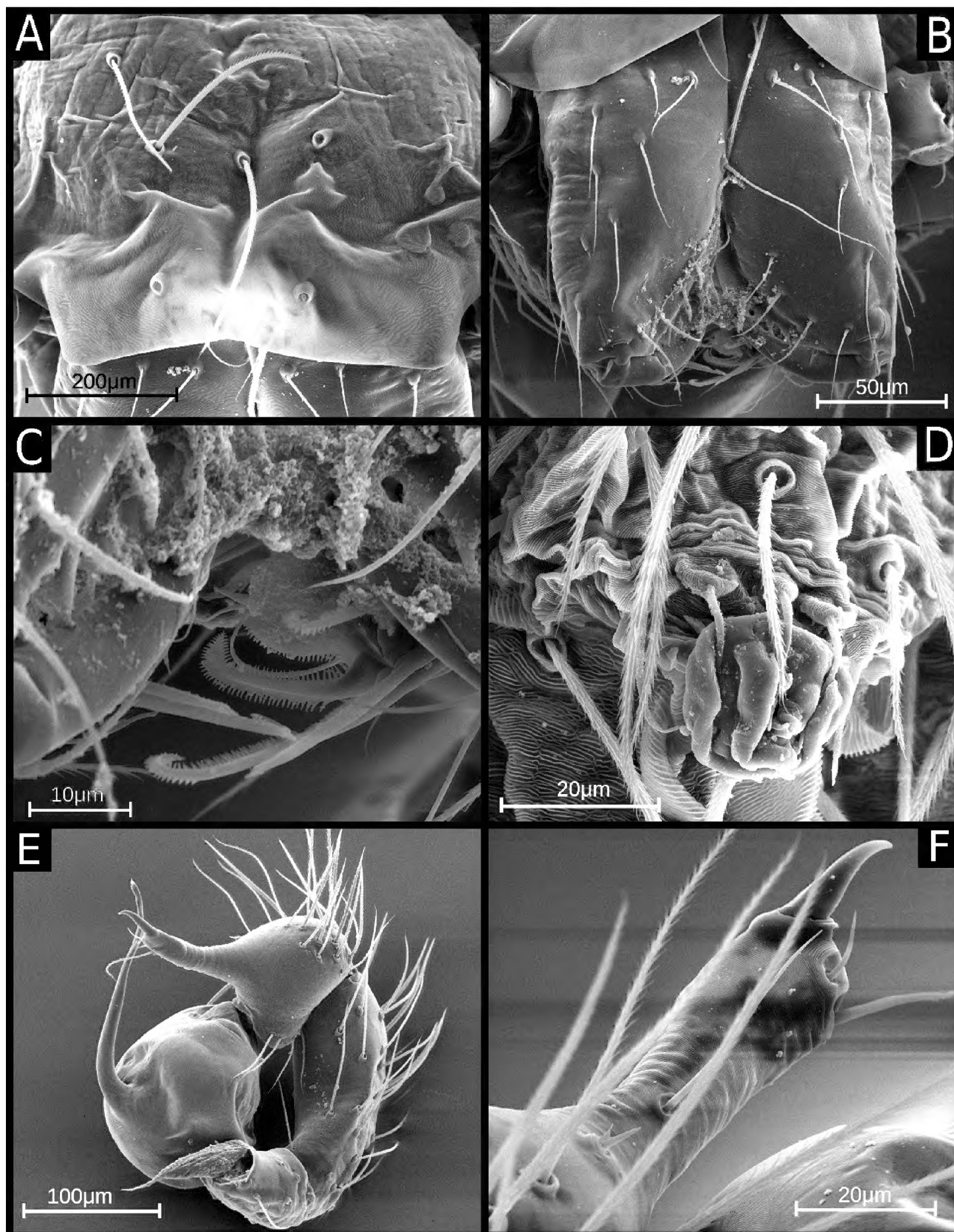




**Figure 1.** *Ochyrocera dorinha* sp. nov., male (IBSP 196433) **A** habitus, dorsal view **B** female (IBSP 196433), habitus, dorsal view **C** left male palp (IBSP 196433) prolateral view **D** same, retrolateral view **E** carapace, dorsal view. Abbreviations: C, cymbium; CE, cymbial extension; E, embolus; T, tegulum.

(IBSP 196432), Mariana, Cave FN\_0027, 01–02/IX/2010, R. Andrade et. al. col.; 1♂ (IBSP 209858), Catas Altas, Cave ALEA\_0010 (20°09'07"S, 43°29'14"W), 19/XI/2019, BioEspeleo Consultoria Ambiental col.; 1♂ (IBSP 186105), Nova Lima, Tutaméia, Cave SC\_0005 (19°57'3"S, 43°53'23"W), 18/XI/2014, M.P.A. Oliveira col.; 2♂ 3♀ (IBSP 186100), Nova Lima, Tutaméia, Cave TUTA\_0029 (20°7'34"S, 43°58'29"W), 24/VII/2014, M.P.A. Oliveira col.; 1♂ 1♀ (IBSP 188950), Rio Acima, Serra do Gandarela, Cave GAND\_0008 (20°06'20"S, 43°40'23"W), 10/II–20/III/2014, Equipe Carste col.; 1♀ (IBSP 179521), Rio Acima, Serra do Gandarela, Cave VG\_0040 (ABOB\_0009) (20°08'59"S, 43°52'28"W), 29/III–01/IV/2011, R. Andrade & I. Cizauskas et al. col.; 1♀ (IBSP 188948), Santa Bárbara, Serra do Gandarela, Cave GAND\_0073 (20°02'22"S, 43°39'29"W), 10/II–20/III/2014, Equipe Carste col.

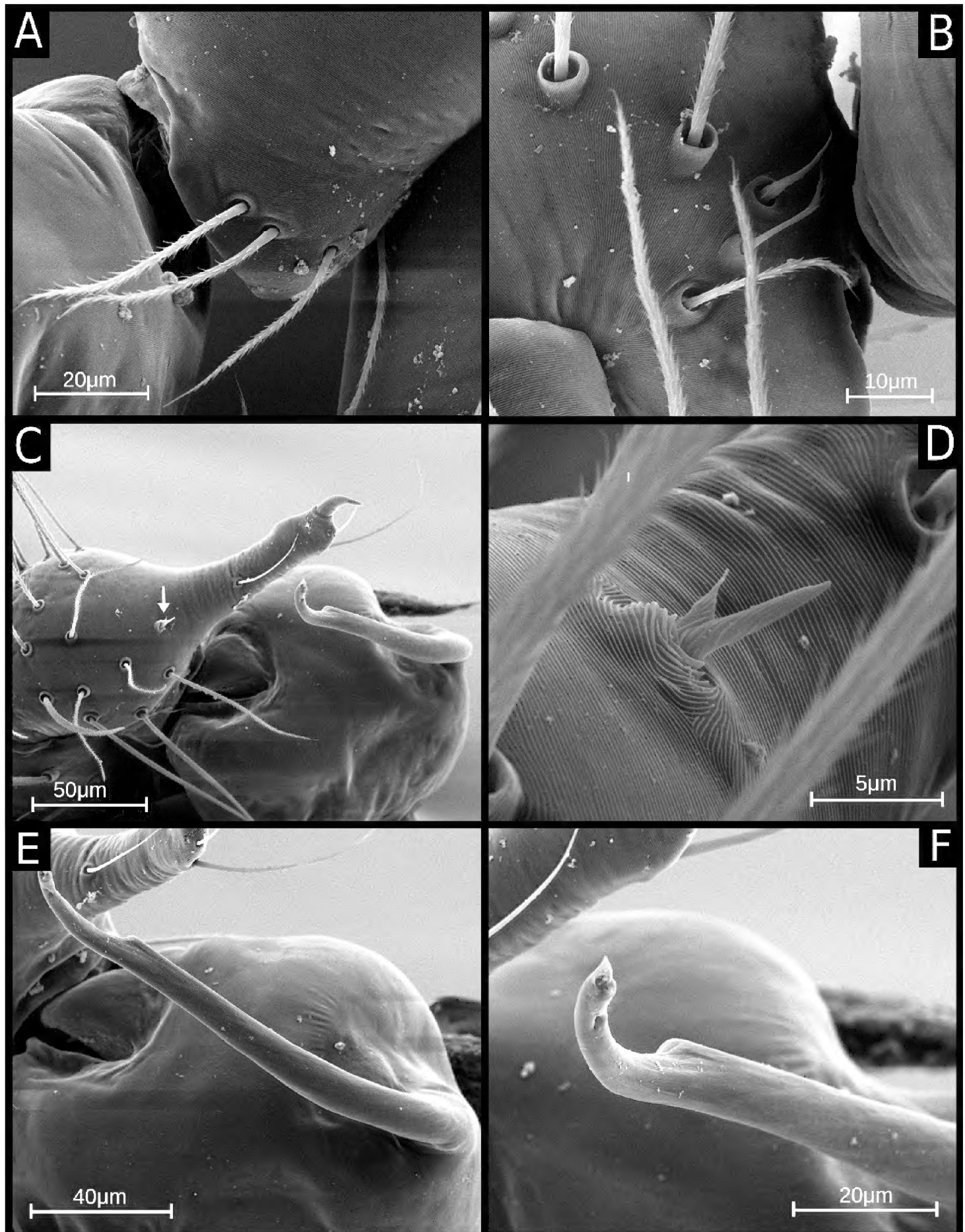
**Etymology.** Noun in apposition is a tribute to the fictional character of the Brazilian “Turma da Mônica” comic books by Maurício de Sousa. Dorinha, created in 2004, is a visually impaired character, in this case blind. She was inspired by Dorina Nowill,



**Figure 2.** SEM images of *Ochyrocera dorinha* sp. nov., male (IBSP 198876) **A** carapace, anterior view **B** chelicerae, frontal view **C** endites, crosier-like macrosetae, dorsal view **D** epiandrous area, abdomen, ventral view **E** male palp, prolateral view **F** cymbium, distal view.

who passed away in 2010 and who chaired the World Council for the Welfare of the Blind, known today as the World Union of the Blind.

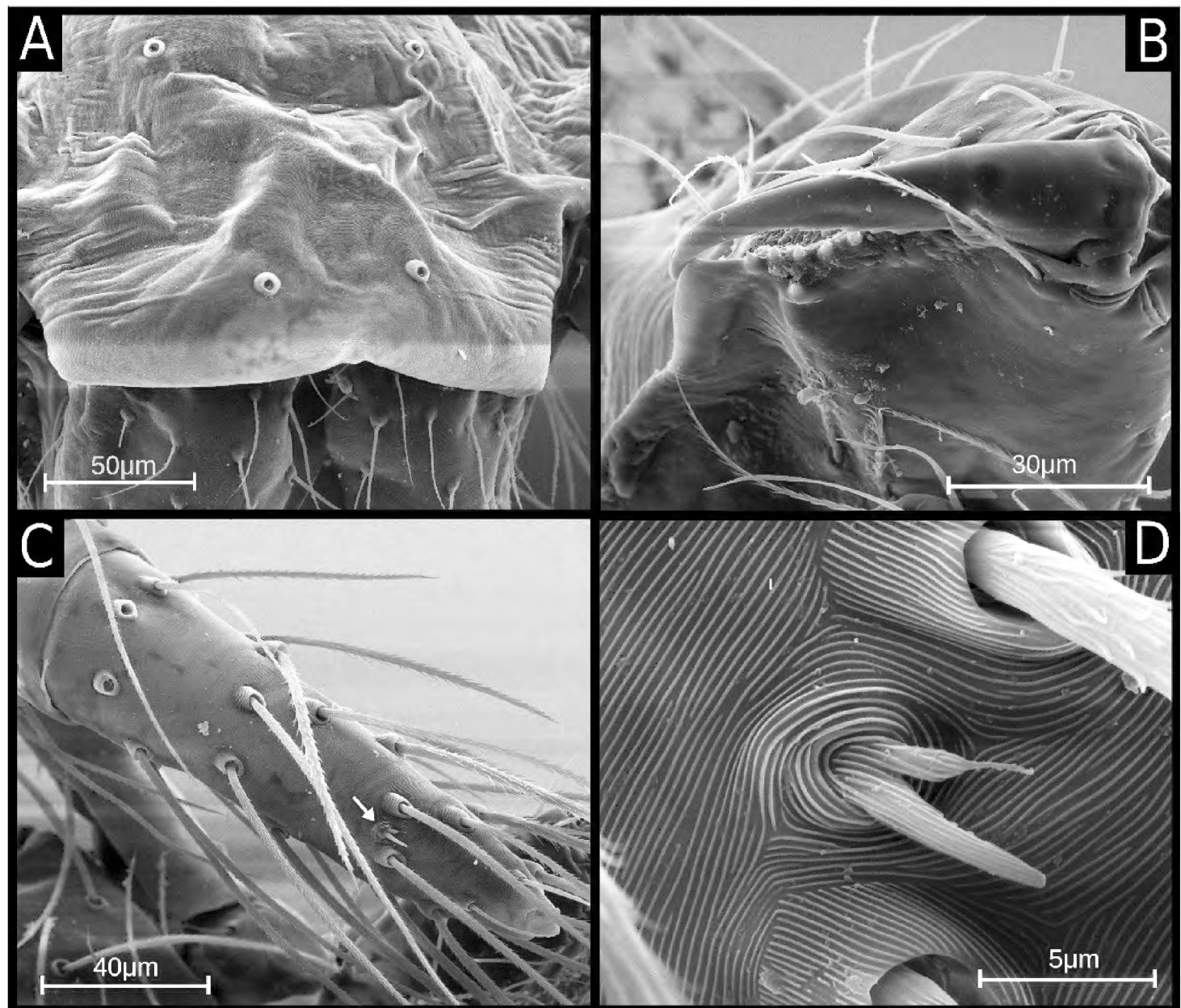
**Diagnosis.** *Ochyrocera dorinha* sp. nov. is easily distinguished from other species of *Ochyrocera* from the state of Minas Gerais by the total absence of eyes (Fig. 1A, B, E).



**Figure 3.** SEM images of *Ochyrocera dorinha* sp. nov., male palp (IBSP 189194) **A** cymbial extension, prolateral view **B** same, prolateral view **C** cymbium and bulb, anterior view **D** cymbium, tarsal organ, detail **E** embolus, ventral view **F** embolus, distal area, detail, ventral view.

This species differs from *Ochyrocera ritxoco* and *O. ritxoo*, both anophthalmic, by having a palp with a globose bulb and flattened distally-narrowed embolus (Figs 1C, D, 2E, 3C, E, F, 5A, B), while the two Amazonian species have an oval bulb and filiform embolus (see Brescovit et al. 2021; figs 2A, B, 8A, B). The female of *Ochyrocera dorinha* sp. nov.



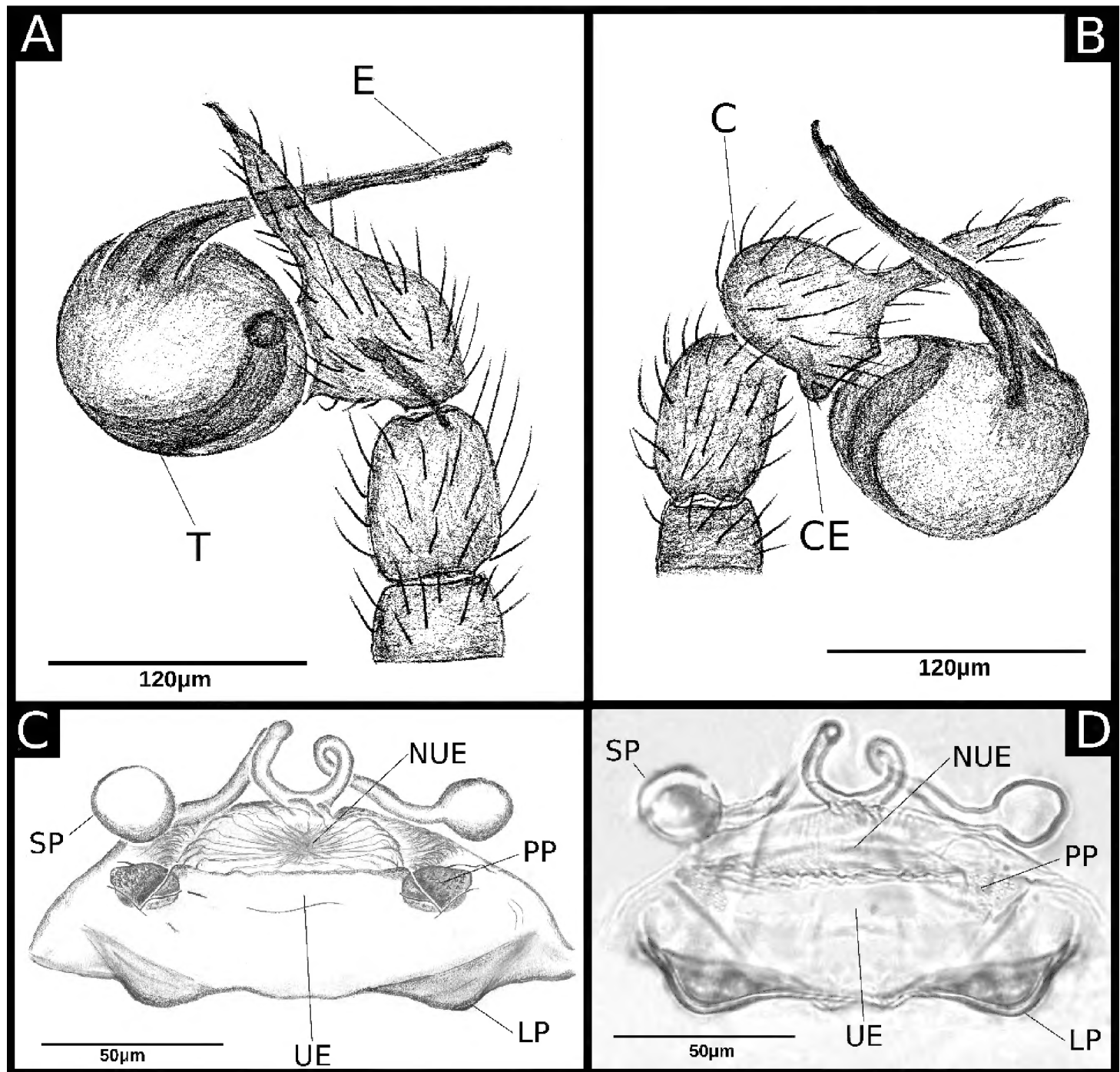


**Figure 4.** SEM images of *Ochyrocera dorinha* sp. nov., female (IBSP 198873) **A** carapace, anterior view **B** chelicerae, frontal view **C** pedipalp, distal, prolateral view **D** same, tarsal organ, detail.

resembles *O. magali* sp. nov. by its long ducts and globose spermathecae (Fig. 7E, F) but differs by having a larger pore plate, and one single U-curve on the ducts of the spermathecae in the genitalia (Fig. 5C, D).

**Description. Male (Holotype IBSP 196428a).** Total length 1.0. Carapace length 0.45, ovoid; narrowing gradually anteriorly; pars cephalic white, flat, fovea absent (Fig. 1A, E). Eyes absent (Figs 1A, B, E, 2A). Chelicerae paturon white; promargin with 5–6 teeth (Fig. 2B) attached to a very long lamina; retromargin without teeth. Endites white, with large serrula with more than 30 denticles, distal macrosetae paired and crosier-like, many multifid macrosetae present (Fig. 2C). Labium white, rounded with 7–8 setae with enlarged base. Sternum white. Legs: white; formula 1423; total lengths: I 5.7; II 5.5; III 4.3; IV 5.4. Male palp: palpal femur length 0.25; palpal tibia enlarged basally, shorter than cymbium (Fig. 2E); cymbium slightly curved distally, bearing apical cuspule in shape of a nail (Figs. 2F, 3C); three retrolateral paired long setae on non-projected base (Fig. 3A), tarsal organ subdistal, with non-elevated base and bifid and elongated proprioceptor (Fig. 3C, D); three basal setae present on rounded





**Figure 5.** *Ochyrocera dorinha* sp. nov., **A** left male palp (IBSP 186100), retrolateral view **B** same, prolateral **C** female genitalia (IBSP 189185), enzyme cleared, dorsal view **D** same, dorsal view. Abbreviations: C, cymbium; CE, cymbial extension; E, embolus; LP, lateral pockets; NUE, neck of uterus externus; PP, pore-plate; SP, spermathecae; T, tegulum, UE, uterus externus.

cymbial prolateral extension (Fig. 3B); bulb globose; embolus flattened, longer than bulb, subdistally narrowed, curved at tip (Fig. 3E, F). Abdomen length 0.55, oval; uniformly yellowish. Six epiandrous spigots with short base (Fig. 2D).

**Female (paratype, IBSP 196428b).** Total length 1.2; carapace length 0.5. Carapace as in male, yellowish-white (Figs 1B, 4A). Pedipalp without claw, with conical tip and subdistal tarsal organ (Fig. 4C, D). Eyes, chelicerae, sternum, endites, and labium as in male, but slightly yellowed (Fig. 4A, B). Legs yellowed; formula 4123, total lengths: I 4.6; II 4.4; III 4.3; IV 4.8. Abdomen length 0.6. Colulus triangular with five bristles. Triangular basal lateral pockets (Fig. 5C, D). Internal genitalia with globose spermathecae, with long and coiled ducts under pore plate. Uterus externus with no

visible chambers and inconspicuous neck. Rounded pore-plates on spermathecae, with approximately 20–30 glandular ducts (Figs 5C, D).

**Variation.** Males (n=10): total length 0.8–1.1; carapace 0.4–0.51; femur I 3.2–3.5. Females (n=10): total length 1.0–1.4; carapace 0.45–0.56; femur I 3.1–3.4.

**Distribution.** Known only from 19 caves on several mountains (Serra da Moeda, Serra do Gandarela, Escarpa Oriental do Caraça, Serra do Tamanduá) in the Quadrilátero Ferrífero, state of Minas Gerais, Brazil (Fig. 14). In general, the species is found in larger caves for this type of lithology (above 30 meters of development), and with the presence of aphotic zones. Its type locality, cave MP\_0008, is an important cave in the region, with numerous other troglobite species (Hoch and Ferreira 2012; Gomes et al. 2019), some of which are extremely rare (e.g., *Ferricixius davidi* Hoch & Ferreira, 2012; Cixiidae, Hemiptera). Inserted in a rupestrian field at an altitude of 1,500 meters, this cave has almost 100 meters of development, with ascending channels, high humidity and low availability of trophic resources.

***Ochyrocera magali* Brescovit, Zampaulo, Pedroso & Cizauskas, sp. nov.**

<http://zoobank.org/7E7220F2-225A-4F90-97F9-2FEF25AD944E>

Figures 6–8, 14

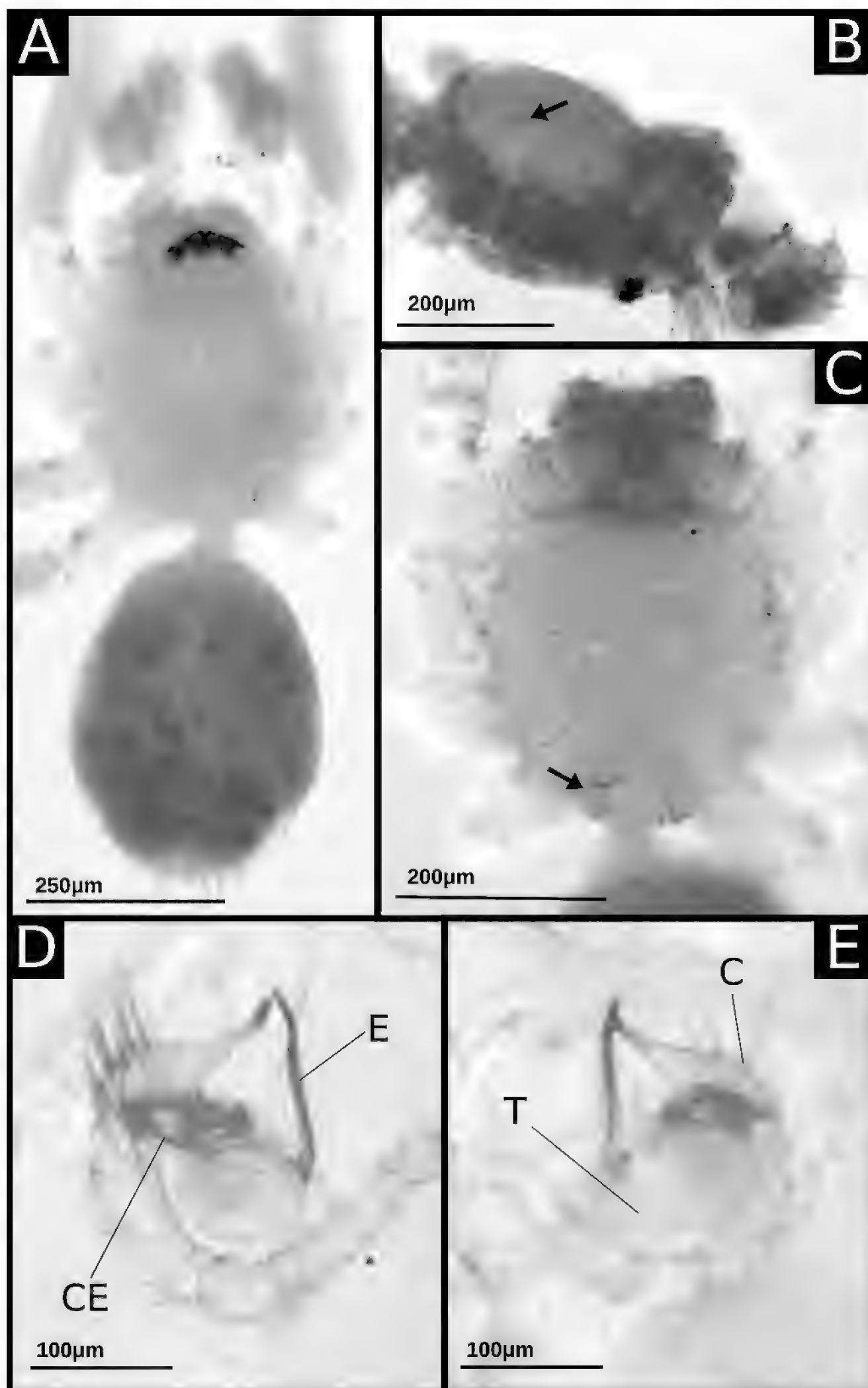
**Type material.** *Holotype* 1♂ (IBSP 196412a) and *paratype* 1♀ (IBSP 196412b), Brazil, Minas Gerais, Quadrilátero Ferrífero, Caeté, Cave APOL\_0017 (20°03'09"S, 43°42'04"W), 30/VI–08/VII/2011, R. Bessi et. al. col.

**Other material examined.** BRAZIL, Minas Gerais, Santa Bárbara, Serra do Gandarela: 1♂ (SEM) 2♀ (IBSP 188946), Cave GAND\_0092 (20°06'10"S, 43°40'05"W); 1♀ (IBSP 188951), Cave GAND\_0113 (20°04'06"S, 43°40'13"W); 1♀ (IBSP 188947), Cave GAND\_0102 (20°05'37"S, 43°41'04"W); all collected in 10/II–20/III/2014 by Equipe Carste.

**Etymology.** Noun in apposition is a tribute to the fictional character of the Brazilian “Turma de Mônica” comic books by Maurício de Sousa, based on his daughter Magali. She is 7 years old and her main characteristic is her voracious appetite. She eats everything, at high speed, and feels hungry all the time, but despite this, friends see her as skinny, without ever putting on weight.

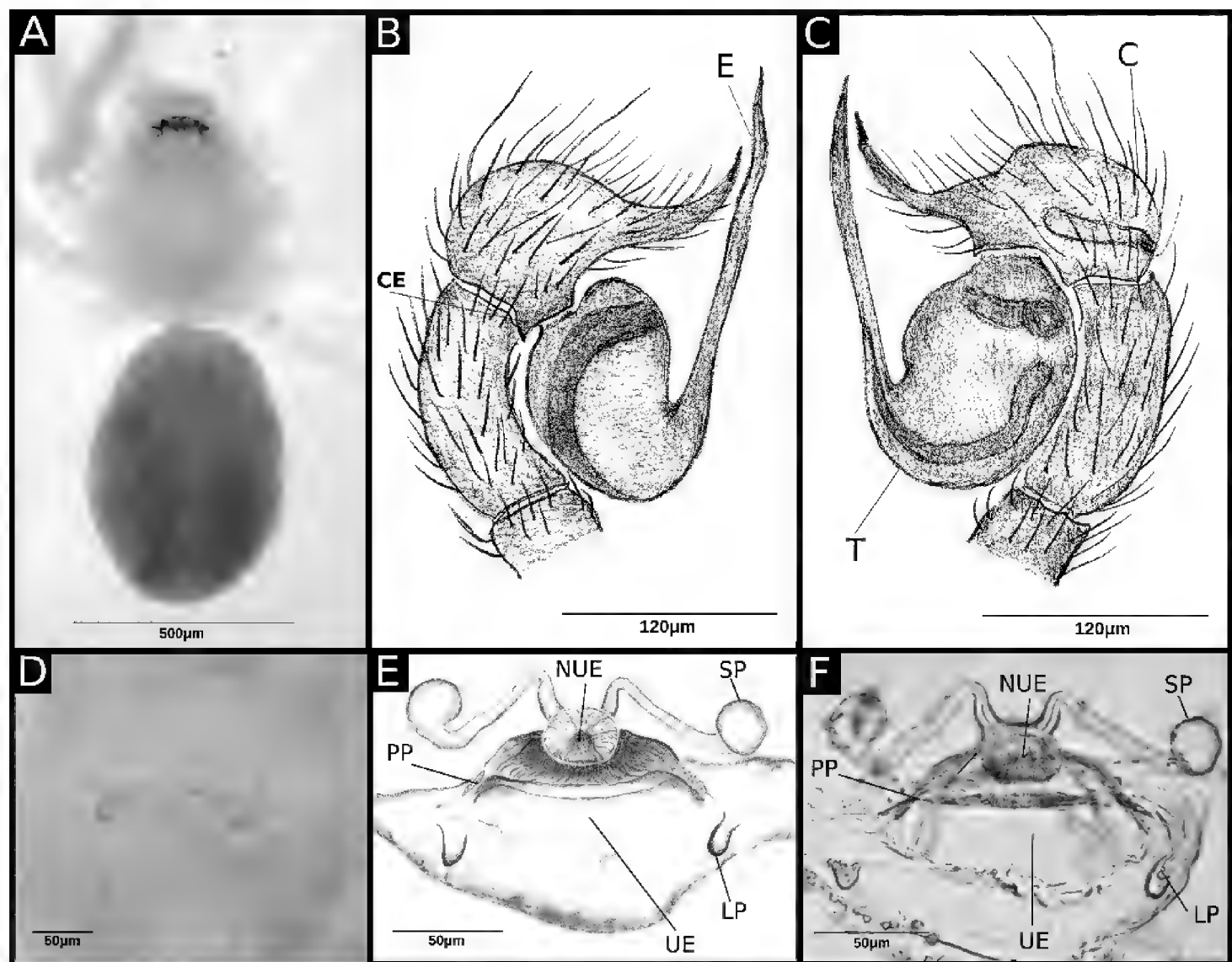
**Diagnosis.** *Ochyrocera magali* sp. nov. differs from other species of *Ochyrocera* by the male having conspicuous elongated setae on the border of the sternum (Fig. 6B, C), a long and apically projected embolus with curved tibiae of the male palp (Figs 6D, E, 8A, B). The female of *Ochyrocera magali* sp. nov. resembles *O. dorinha* sp. nov. by its long ducts and globose spermathecae (Fig. 5C, D) but differs by its small pore plate and not coiled ducts of the spermathecae in the genitalia and lateral pockets small and elongated (Fig. 7E, F).

**Description. Male (Holotype IBSP 196412a).** Total length 0.8. Carapace length 0.45, ovoid; rounded anteriorly; pars cephalic white, flat; fovea absent (Fig. 6A). Clypeus length 0.03, with pair of long bristles (Fig. 6A, B). Eyes: with black edges, PME oval;



**Figure 6.** *Ochyrocera magali* sp. nov., male (IBSP 196412) **A** habitus, dorsal view **B** carapace, lateral view, arrows indicating the long and thin setae **C** sternum, ventral view **D** male palp, retrolateral view **E** same, prolateral view. Abbreviations: C, cymbium; CE, cymbial extension; E, embolus; T, tegulum.

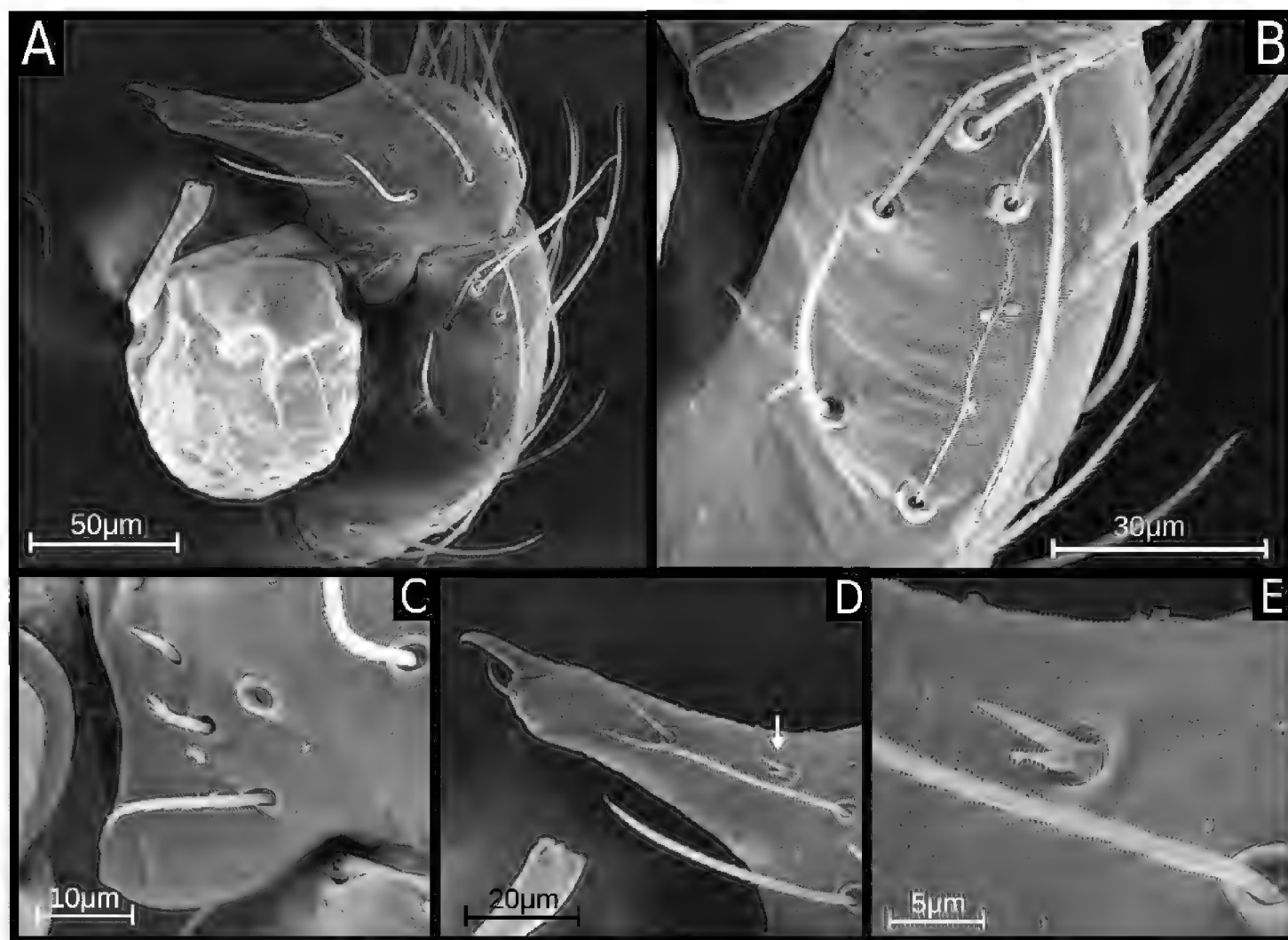




**Figure 7.** *Ochyrocera magali* sp. nov., female (IBSP 196412) **A** habitus, dorsal view **B** male palp, retrolateral view **C** same, prolateral view **D** same, dorsal view **E** epyginal plate, ventral view **F** female genitalia (IBSP 188947), enzyme cleared, dorsal view. Abbreviations: C, cymbium; CE, cymbial extension, E, embolus, LP, lateral pockets, NUE, neck of uterus externus; PP, pore-plate, SP, spermathecae; T, tegulum; UE, uterus externus.

ALE and PLE rounded, all approximately the same size. Chelicerae paturon white with yellowish fang; promargin with 6 teeth attached to a long lamina; retromargin without teeth. Endites white with large serrula with more than 30 denticles, distal macrosetae paired and crosier-like, many multifid macrosetae present. Labium white, rounded with 6–8 setae with enlarged base. Sternum white with long, thin setae on posterior edge (Fig. 6B, C). Legs: light grey; formula 1423; total lengths: I 1.8; II 1.6; III 1.4; IV 1.7. Male palp: palpal femur length 0.03; palpal tibia longer than cymbium, slightly curved (Fig. 8A, B); cymbium slightly curved dorsally, bearing short apical cuspule (Fig. 6D, 8A, D); retrolateral paired long setae on non-projected base, tarsal organ subdistal, with non-elevated base and bifid and elongated proprioceptor (Fig. 8A, E); three basal setae present on rounded cymbial prolateral extension (Fig. 8C); bulb oval; embolus flattened, very long, apically projected, with sinuous tip (Figs 6D, E, 7B, C). Abdomen length 0.35, oval; uniformly yellowish-white (Fig. 6A). Six epiandrous spigots with short base.

**Female (Paratype, IBSP 196412b).** Total length 1.0; carapace length 0.4. Carapace as in male (Fig. 7A). Pedipalp without claw, with conical tip and subdistal tarsal organ, as in other species (Fig. 4C). Clypeus: diameter 0.03. Eyes, chelicerae, sternum,



**Figure 8.** SEM images of *Ochyrocera magali* sp. nov., male palp (IBSP 188946) **A** cymbium and bulb, retrolateral view **B** palpal tibiae, retrolateral view **C** cymbium, distal area, retrolateral view **D** cymbial extension, retrolateral view, arrow indicating the tarsal organ **E** cymbium, tarsal organ, detail.

endites, and labium as in male. Legs as in male; formula 4123, total lengths: I 1.7; II 1.9; III 1.4; IV 2.0. Colulus triangular with approximately 6–8 bristles. Epigynal plate slightly sclerotized, with sulcate lateral borders (Fig. 7D), and small and elongated lateral pockets (Fig. 7E). Internal genitalia with globose spermathecae with long ducts curved at base; short medial columnar uterus externus with no visible chambers internally and inconspicuous neck. Rounded and reduced pore-plates with approximately 15–20 glandular ducts (Fig. 7E, F). Abdomen slightly grey, length 0.5 (Fig. 7A).

**Variation.** No variation was found between the specimens.

**Distribution.** Known only from four ferruginous caves in the municipalities of Caeté and Santa Bárbara, in the Quadrilátero Ferrífero, state of Minas Gerais, Brazil (Fig. 14).

***Ochyrocera monica* Brescovit, Zampaulo, Pedroso & Cizauskas, sp. nov.**

<http://zoobank.org/66894C8D-50D9-45B4-A079-06A4E9D00E50>

Figures 9, 10, 14

**Type material.** *Holotype* 1♂ (IBSP 196679a) and *paratype* 1♀ (IBSP 196679b), BRAZIL, Minas Gerais, Quadrilátero Ferrífero, Barão de Cocais, Cave RF\_0058 (19°56'04"S, 43°31'31"W), 22/VI–03/VII/2009, R. Bessi et al. col. **Paratypes:**

1♂, 2♀ (UFMG 25398), BRAZIL, Minas Gerais: Barão de Cocais, Cave RF\_0049 (19°55'45"S, 43°30'46"W), 22/VI-03/VII/2009, R. Bessi et al. col.

**Other material examined.** BRAZIL, Minas Gerais: 2♀ (IBSP 196676), Barão de Cocais, Cave RF\_0058; 1♀ (IBSP 196677), Barão de Cocais, Cave RF\_0041 (19°55'41"S, 43°30'34"W); 8♀ (IBSP 196678), Barão de Cocais, Cave RF\_0049 (19°55'45"S, 43°30'46"W); 1♀ (IBSP 196680), Barão de Cocais, Cave RF\_0043 (19°55'42"S, 43°30'33"W), all collected in 10–21/III/2009 by R. Andrade et al col.; 6♀ (IBSP 264547), Barão de Cocais, Cave RF\_0058; 1♂ 2♀ (IBSP 196681), Barão de Cocais, Cave RF\_0049; all collected in 22/VI-03/VII/2009 by R. Bessi et al; 1♂ 2♀ (IBSP 264547), Mariana, Cave LTA\_0043 (20°11'05"S, 43°31'27"W), 20/VIII/2020, BioEspeleo Cons. Ambiental col.; 1♂ 2♀ (IBSP 264096), Mariana, Cave LTA\_0047 (20°11'05"S, 43°31'27"W), 20/VIII/2020, BioEspeleo Cons. Ambiental col.

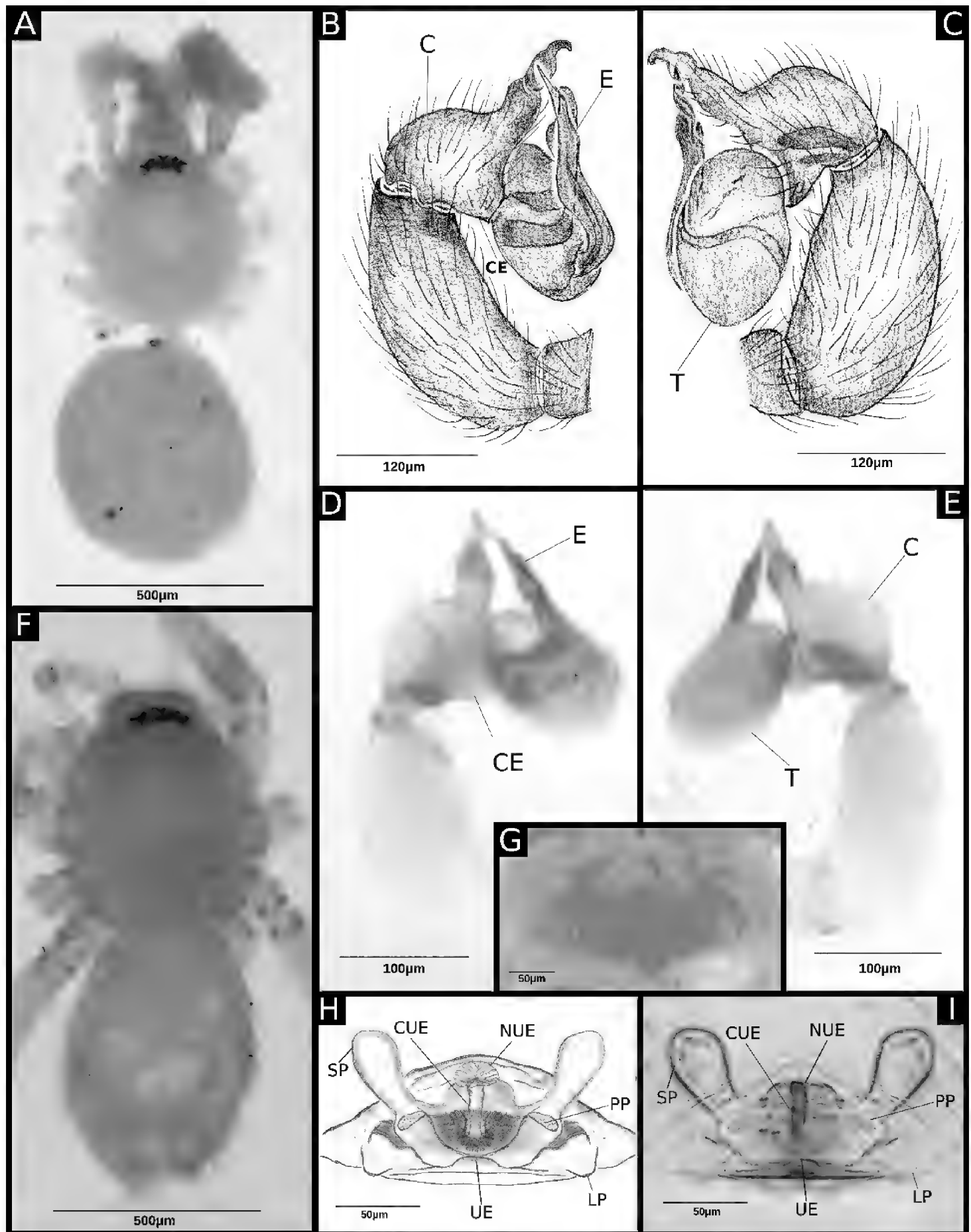
**Etymology.** Noun in apposition is a tribute to the fictional character of the Brazilian “Turma da Mônica” comic books by Maurício de Sousa. She is one of the main characters, along with her friend Cebolinha. She is a girl of strong genius, who has no patience for the nicknames she receives from other children because of her physical appearance and usually responds to such actions with her extreme brute strength, far superior to that of a girl her age.

**Diagnosis.** *Ochyrocera monica* sp. nov. is distinguished from the other species of *Ochyrocera* from the Quadrilátero Ferrífero by having cymbium with a conspicuous apical cuspule, enlarged palpal tibiae and elongated and sinuous embolus with a coiled tip (Fig. 9B–E). The female of *Ochyrocera monica* sp. nov. differs from other species by its large and elongated spermathecae and narrow and smooth columnar uterus externus (Fig. 9H, I).

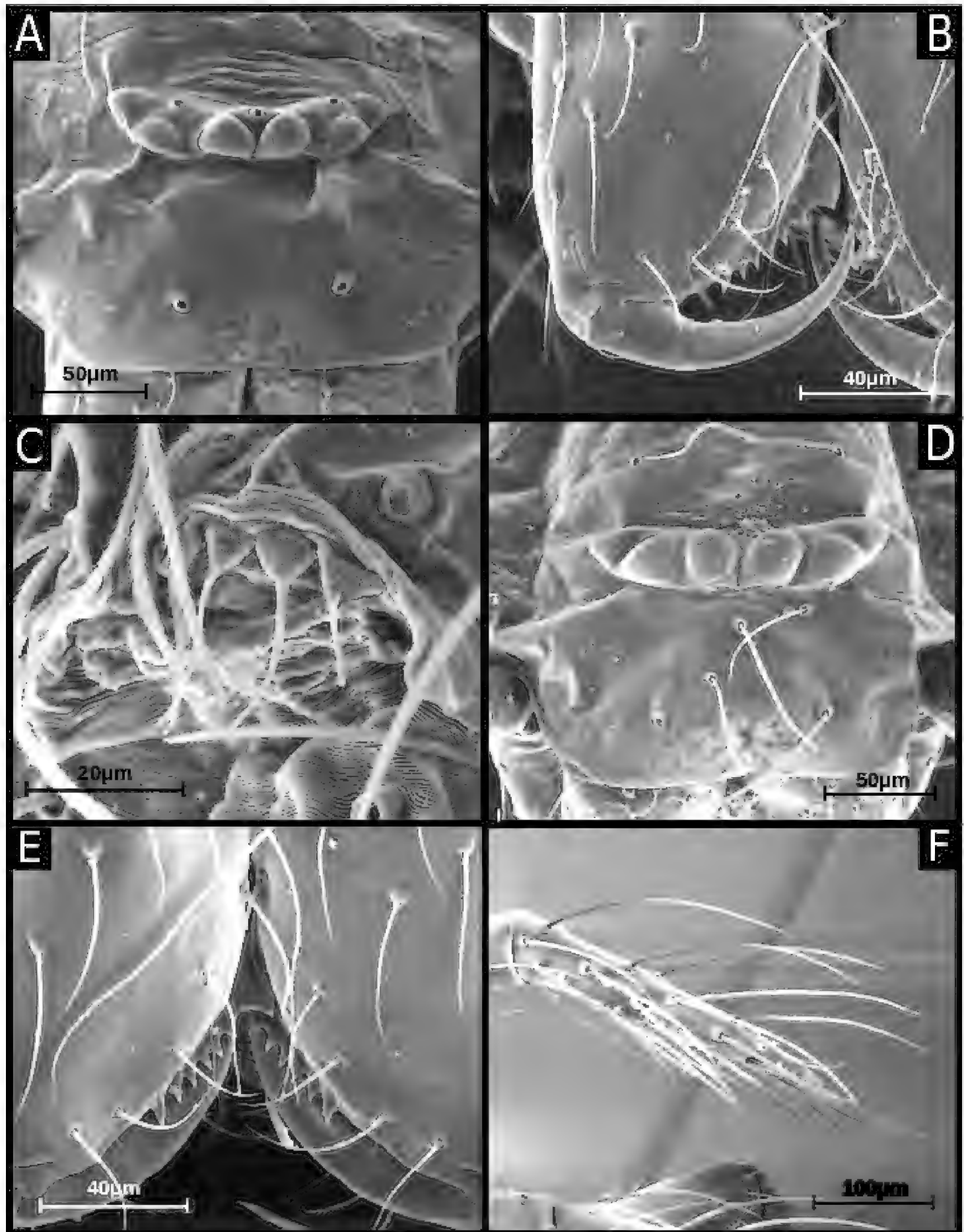
**Description. Male (Holotype, IBSP 196679a).** Total length 0.8. Carapace length 0.4, ovoid; narrowing gradually anteriorly; pars cephalic yellowish, flat, fovea absent (Fig. 9A). Clypeus length 0.06, with a pair of long bristles (Fig. 10A, broken in the photo). Eyes (Fig. 10A): with black edges, PME oval, slightly larger than others, ALE and PLE rounded. Chelicerae white; promargin with 6 teeth attached to very long lamina (Fig. 10B); retromargin without teeth. Endites cream, with large serrula with more than 30 denticles, distal macrosetae paired and crosier-like, many multifid macrosetae present. Labium white, rounded with 6–8 setae with enlarged base. Sternum white. Legs: yellowish; formula 1423; total lengths: I 4.7; II 4.9; III 3.8; IV 5.1. Male palp: palpal femur length 0.22; palpal tibia longer than cymbium, enlarged basally; cymbium with short distal projection, bearing short apical cuspule, with thickened base; retrolateral paired long setae on non-projected base (Fig. 9B, D), tarsal organ subdistal, with non-elevated base and bifid and elongated proprioceptor, three basal setae present on rounded cymbial prolateral extension; bulb oval; embolus long, ribbon-like, distal third coiled (Fig. 9B–E). Abdomen length 0.5, oval; uniformly yellowish. Six epiandrous spigots with short base (Fig. 10C).

**Female (Paratype, IBSP 196679b).** Total length: 0.9; carapace length: 0.4; Carapace as in male, yellowish white (Fig. 9F). Pedipalp thin, without claw, with coni-





**Figure 9.** *Ochyrocera monica* sp. nov., male (IBSP 196681) **A** habitus, dorsal view **B** palp, prolateral view **C** same, retrolateral view **D** same, retrolateral view **E** same, prolateral view **F** habitus, dorsal view, female (IBSP 196676) **G** epigynal plate, ventral view **H** internal genitalia, dorsal view **I** same, enzyme cleared, dorsal view. Abbreviations: C, cymbium; CE, cymbial extension; E, embolus; LP, lateral pockets; NUE, neck of uterus externus; PP, pore-plate; SP, spermathecae; T, tegulum; UE, uterus externus.



**Figure 10.** SEM images of *Ochyrocera monica* sp. nov., male (IBSP 196681) **A** carapace, anterior view **B** chelicerae, frontal view **C** epiandrous area, abdomen, ventral view **D** female (IBSP 196676), carapace, dorsal view **E** chelicerae, frontal view **F** pedipalp, prolateral view.

cal tip; trichobothrium subdistal, with elongated base (Fig. 10F). Clypeus: diameter 0.05, with three pairs of long bristles (Fig. 10D). Eyes, chelicerae, sternum, endites (Fig. 10D, E) and labium as in male. Legs as in male; formula 4123, total lengths:

I 5.8; II 5.5; III 3.6; IV 5.3. Abdomen length 0.5. Colulus triangular with approximately 6–8 bristles. Epigynal plate slightly sclerotized, with small sulcate lateral borders (Fig. 9G). Internal genitalia with elongated and distally enlarged spermathecae under small oval pore-plate; elongated and cylindrical medial columnar uterus externus, no visible chambers internally. Uterus externus ending in a narrow neck and with V-shaped sulcus latero-basally. Oval pore-plates on spermathecae with approximately 20–25 glandular ducts (Fig. 9H, I).

**Variation.** Males ( $n = 3$ ): total length 0.7–0.8; carapace 0.4–0.55; femur I 0.46–0.48. Females ( $n=10$ ): total length 0.9–0.11; carapace 0.35–0.5; femur I 0.56–0.59.

**Distribution.** Known only from six iron caves located in the municipalities of Barão de Cocais and Mariana, in the Quadrilátero Ferrífero, state of Minas Gerais, Brazil (Fig. 14).

***Ochyrocera rosinha* Brescovit, Zampaulo, Pedroso & Cizauskas, sp. nov.**

<http://zoobank.org/96DA3A6C-3B97-41E3-9B6F-0DCFF2DB13A9>

Figures 11–13, 14

**Type material.** *Holotype* 1♂ (IBSP 196435a) and *paratype* 1♀ (IBSP 196435b), BRAZIL, Minas Gerais, Serra do Espinhaço, Morro do Pilar, Lapa do Grotão, Cave MP\_0001 (Fig. 16) (19°09'15"S, 43°24'13"W), 03–06/X/2011, R. Andrade et. al. col. Paratypes: 2♂ 1♀ (UFMG 25397), same data as holotype.

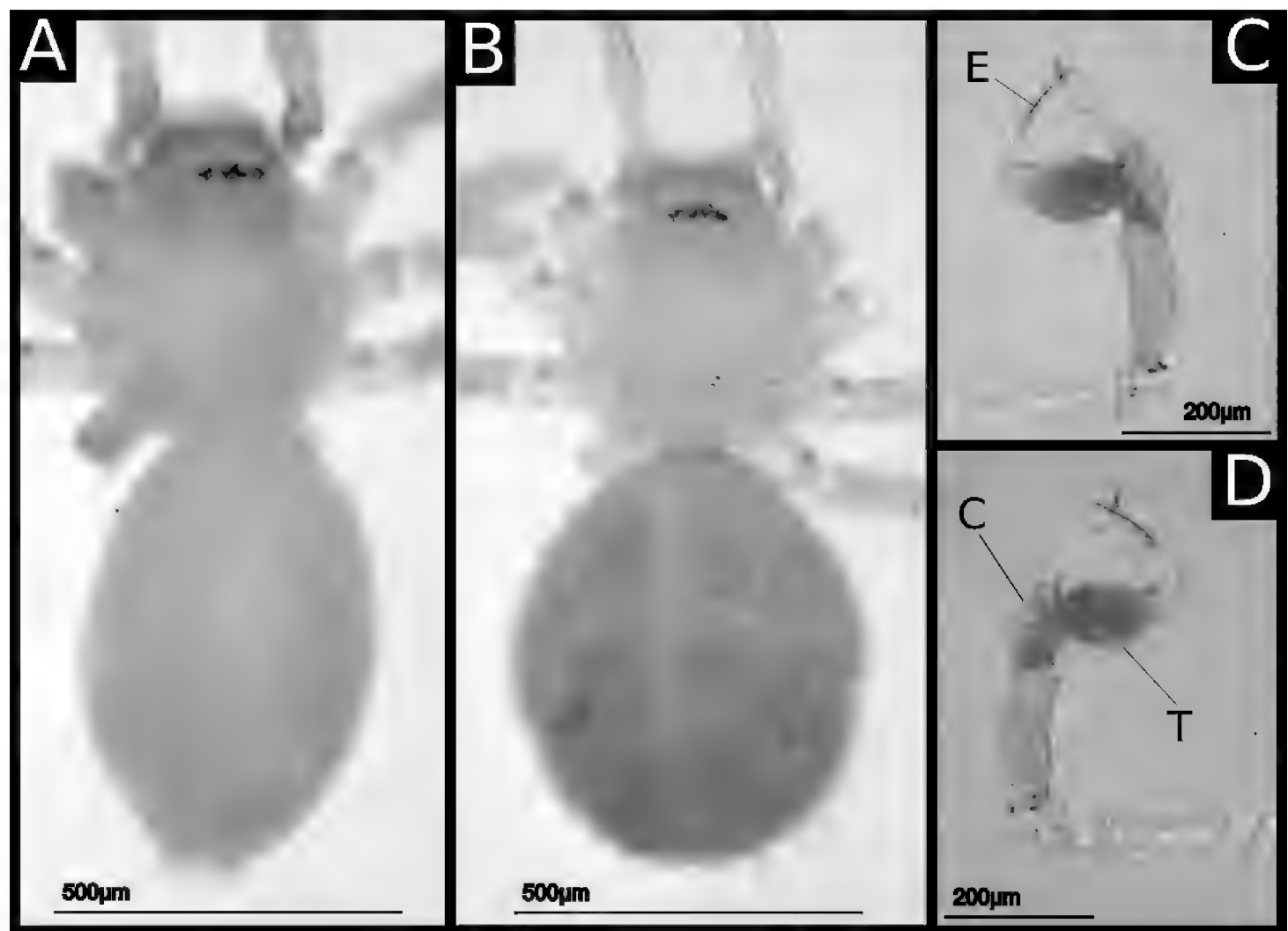
**Other material examined.** BRAZIL, Minas Gerais, Morro do Pilar, Lapa do Grotão: 1♀ (IBSP 196434), 1♀ (IBSP 196439); 1♀ (IBSP 196436); 1♀ (IBSP 196437); 1♀ (IBSP 196438); 28/II/2012, 1♀ (IBSP 196440); 1♂ (IBSP 196441); 2♀ (IBSP 196442); 3♀ (IBSP 196443), Cave MP\_0001, 03–06/X/2011, R. Andrade et. al. col.; 4♀ (UFLA 60680), Cave SPT\_0316 (19°13'17"S, 43°23'25"W), 01/IX/2018, L.M. Rabelo et al. col.

**Etymology.** Noun in apposition is a tribute to the fictional character of the Brazilian “Turma da Mônica” comic books by Maurício de Sousa. She is a country girl, who is always wearing a red dress and a pair of pigtails in her hair. She never walks barefoot and she often speaks wrongly like a hick from the interior of Brazil.

**Diagnosis.** *Ochyrocera rosinha* sp. nov. is distinguished from the other species of *Ochyrocera* from the Quadrilátero Ferrífero by having a cymbium with a long apex, aciculiform cuspule, long and narrow palpal tibiae and filiform embolus, longer than cymbium (Figs 11C, D, 13A, B). The female of *Ochyrocera rosinha* sp. nov. differs from other species by its short and reniform spermathecae and very large pore plates (Fig. 13C, D).

**Description. Male (Holotype, IBSP 196435a).** Total length 1.4. Carapace length 0.5, ovoid; gradually narrowing anteriorly; yellowish-white, pars cephalic flat, fovea absent (Fig. 11A). Clypeus length 0.03, with pair of long bristles. Eyes: with black edges (Fig. 11A), PME oval, slightly larger than others; ALE and PLE rounded. Chelicerae white with yellowish fang; promargin with 6 teeth attached to very long lamina; retro-margin without teeth. Endites cream, with large serrula with more than 30 denticles,

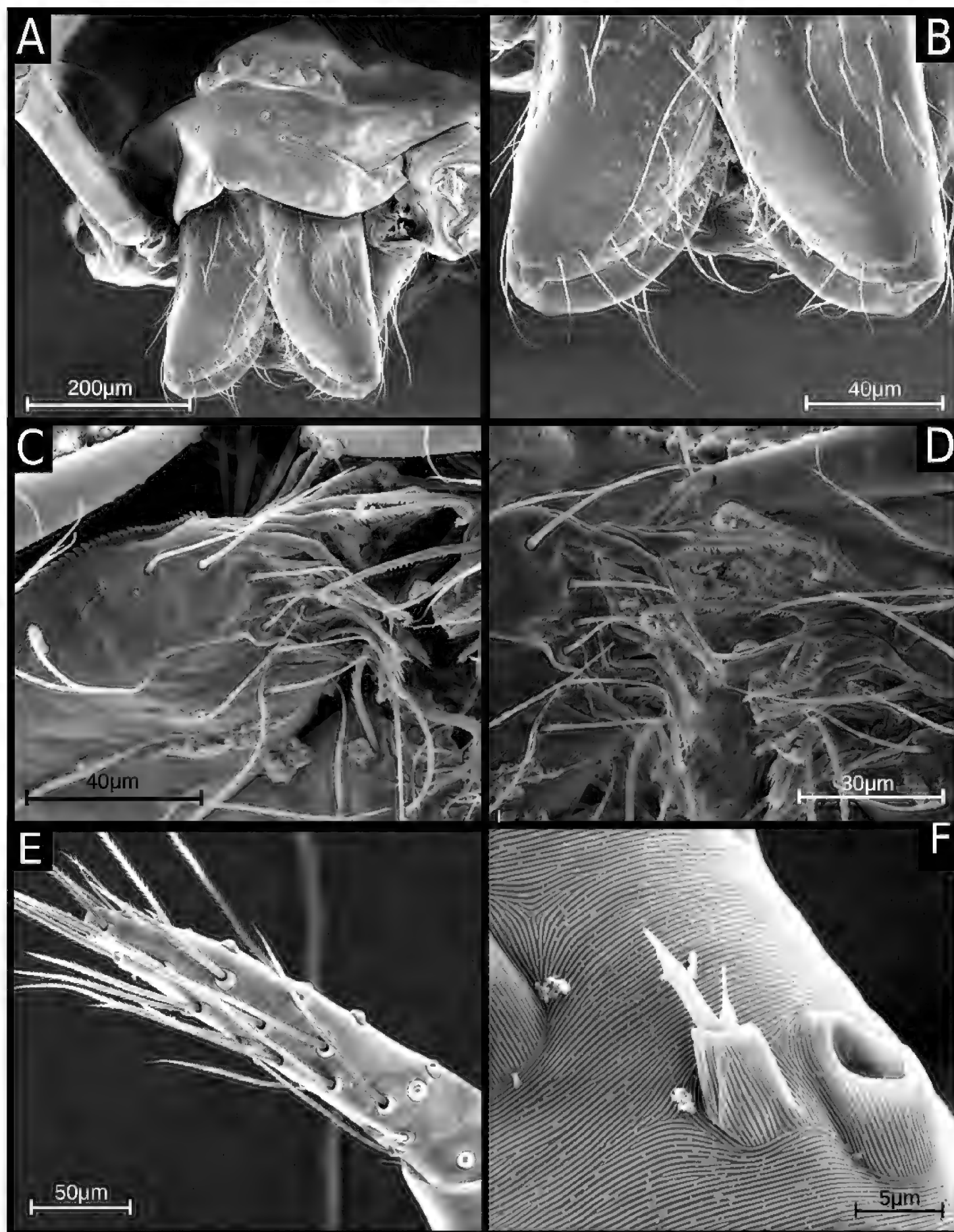




**Figure 11.** *Ochyrocera rosinha* sp. nov., male (IBSP 196435) **A** habitus, dorsal view **B** female (UFLA 60680), habitus, dorsal view **C** left male palp, prolateral view **D** same, retrolateral view. Abbreviations: C, cymbium; E, embolus; T, tegulum.

distal macrosetae paired and crosier-like, many multifid macrosetae present. Labium white, rounded with 6–8 setae with enlarged base. Sternum white. Legs: cream; formula 1423; total lengths: I 5.3; II 4.9; III 4.4; IV 5.1. Male palp: palpal femur length 0.05; palpal tibia as long as cymbium, not curved; cymbium strongly tapered at tip, bearing long and thin apical cuspule; retrolateral paired long setae on non-projected base, tarsal organ subdistal, with non-elevated base and bifid and elongated proprioceptor, with three basal setae on rounded cymbial prolateral extension; bulb oval; embolus longer than cymbium, tapering to apex (Figs 11C, D, 13A, B). Abdomen length 0.8, oval; uniformly yellowish-white (Fig. 11A). Six epiandrous spigots with short base.

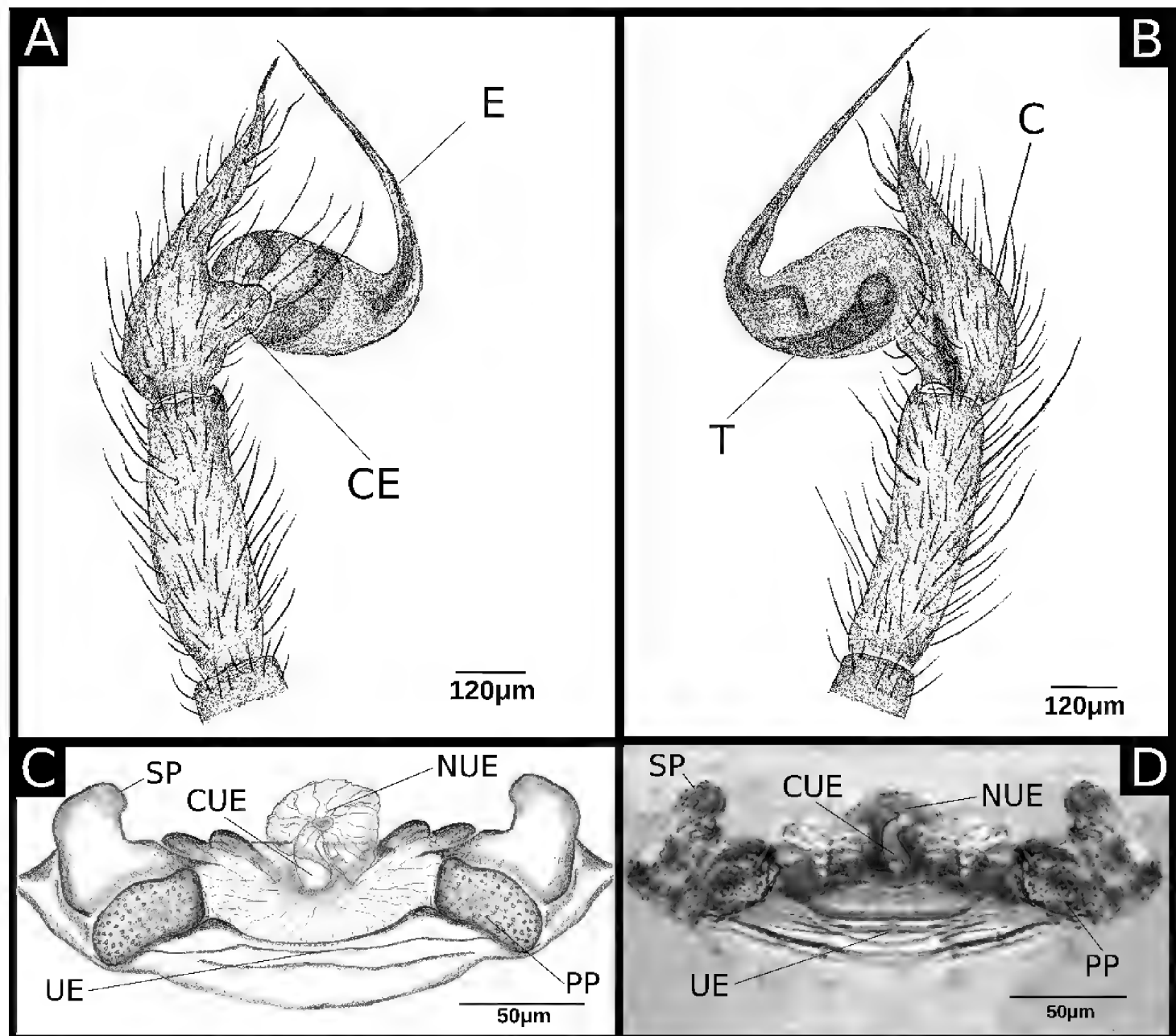
**Female (paratype, IBSP 196435b).** Total length: 1.5; carapace length: 0.5. Carapace as in male, white (Fig. 11B). Pedipalp without claw, with conical tip and subdistal tarsal organ (Fig. 12E, F). Clypeus: diameter 0.03, with three pairs of long bristles (Fig. 12A, broken in the photo). Eyes, chelicerae, sternum, endites, and labium (Figs 11B, 12A–D) as in male. Legs as in male; formula 4123, total lengths: I 5.2; II 5.0; III 4.2; IV 5.4. Internal genitalia with short and enlarged spermathecae under conspicuous pore-plate; medial columnar uterus externus, no visible chambers internally. Uterus externus ending in narrow neck. Oval pore-plates on spermathecae with approximately 30–40 glandular ducts (Fig. 13C, D). Abdomen length 0.8 (11B). Colulus triangular with approximately 8 bristles.



**Figure 12.** SEM images of *Ochyrocera rosinha* sp. nov., female (UFLA 60680) **A** carapace, anterior view **B** chelicerae, frontal view **C** endites, ventral view **D** same, crosier-like macrosetae, detail **E** pedipalp, distal view **F** same, tarsal organ, detail.

**Variation.** Males (n=4): total length 1.2–1.4; carapace 0.5–0.6; femur I 1.7–2. Females (n=10): total length 1.3–1.6; carapace 0.5–0.7; femur I 1.5–1.8.

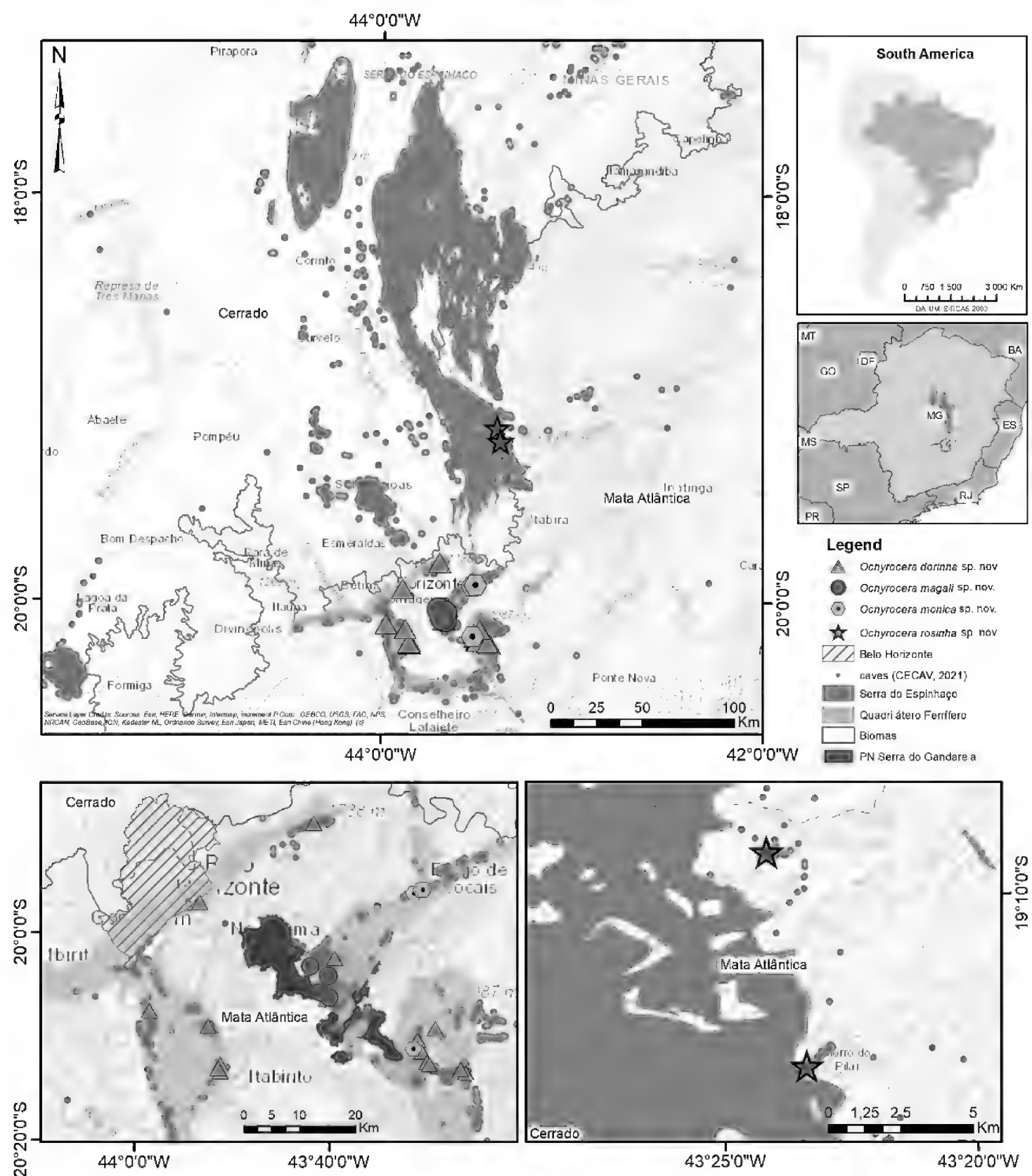
**Distribution.** Known from the Lapa do Grotão cave system and SPT\_0316 cave located in Southern Serra do Espinhaço, municipality of Morro do Pilar, state of Mi-



**Figure 13.** *Ochyrocera rosinha* sp. nov., **A** left male palp (IBSP 196441), retrolateral view **B** same, prolateral **C** female genitalia (UFLA 60680), dorsal view **D** same, enzyme cleared, dorsal view. Abbreviations: C, cymbium; CE, cymbial extension; CUE, columnar uterus externus; E, embolus; NUE, neck of uterus externus; PP, pore-plate; SP, spermathecae; T, tegulum; UE, uterus externus.

nas Gerais, Brazil (Fig. 14). The Lapa do Grotão cave system, unlike the vast majority of ferruginous caves, is part of a perennial drainage system. This system is formed by two large caves (MP-0001A with 290 meters and MP-0001B with 451m) separated by a large doline (large circular doline with a diameter of approximately 45 m and a depth of 30 m). Both caves develop in the contact zone between iron formation rocks (itabirite) and siliciclastic rocks (quartzites). The system is located in an area of riparian forest and is associated with the Lages stream, which is mainly responsible for contributing organic matter to the underground environment. The system receives part of the flow from the Lages stream, which drains towards a sink located in its central west portion where there is a large well (Coelho and Leão 2015). In addition to *O. rosinha* sp. nov., several other troglomorphic species were found in this cave (R. Zampaulo, pers. obs.). Of these, only the harvestman species *Gonycranaus pluto* Bragagnolo, Hara & Pinto-da-Rocha, 2015 (Gerdesiidae, Opiliones) has been described so far.

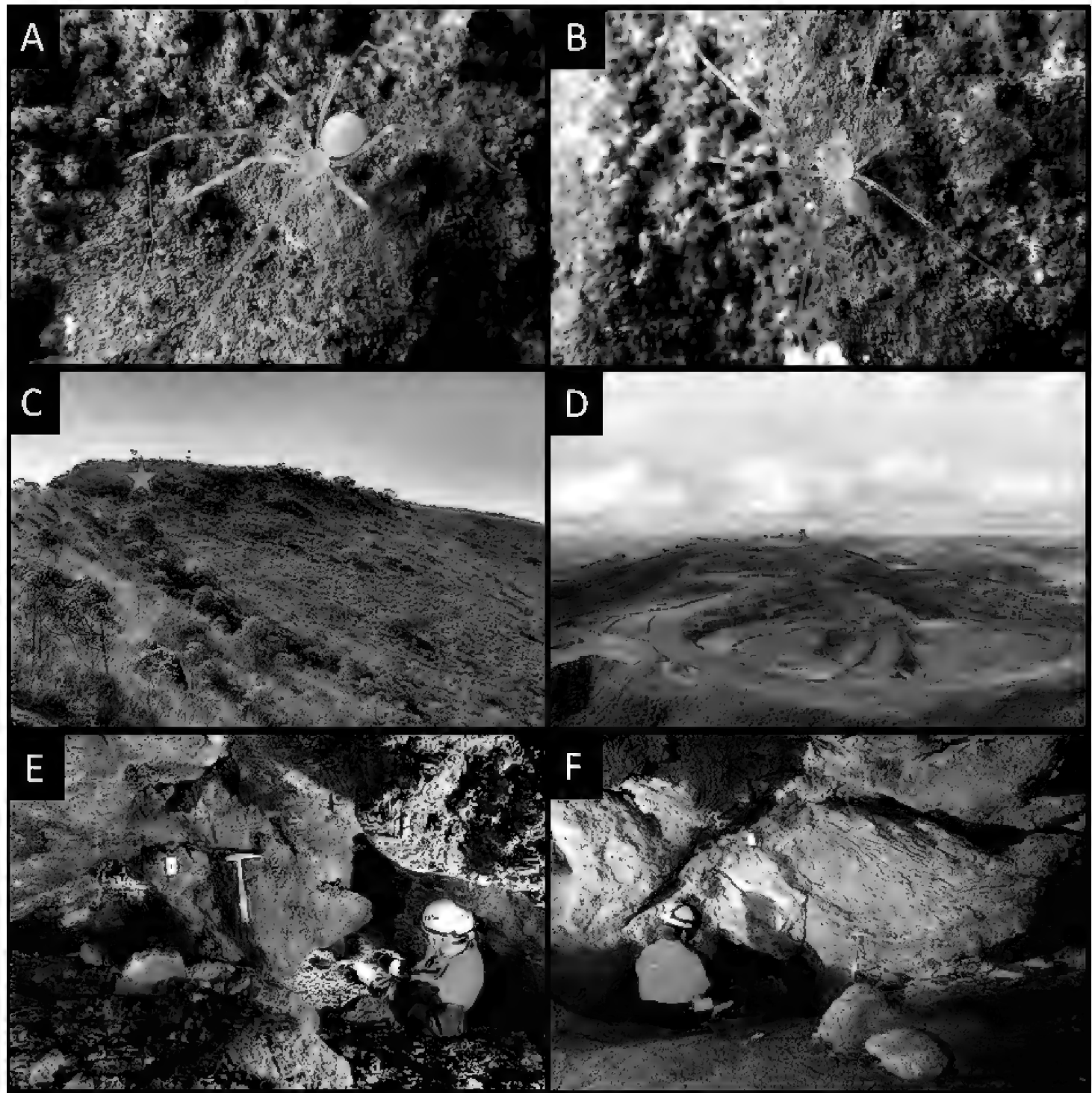




**Figure 14.** Distribution map of the four new species of *Ochyrocera* from the state of Minas Gerais (MG), Brazil: *O. dorinha* sp. nov. (yellow triangles), *O. magali* sp. nov. (blue circles), *O. monica* sp. nov. (pink circles), and *O. rosinha* sp. nov. (green stars).

Discussion

The discovery of a new anophthalmic species of *Ochyrocera* for the state of Minas Gerais, an area ca 2250 km from the state of Pará where the other two anophthalmic species were recently described (Brescovit et al. 2021), shows that the diversity of spiders with this morphological condition is greater than previously thought.



**Figure 15.** *Ochyrocerca dorinha* sp. nov. **A** female **B** male **C** Landscape where cave MP\_0008 is located (type locality). The yellow star represents the exact location where the cave is inserted **D** Mining located around cave MP\_0008 **E** Entrance to cave MP\_0008 **F** Internal aspect of cave MP\_0008 (iron cave).

At first sight, the condition of the total absence of eyes and depigmentation of *Ochyrocerca dorinha* sp. nov. suggests an affinity with *O. ritxoco* Brescovit, Zampaulo & Cizauskas, 2021 and *O. ritxoo* Brescovit, Zampaulo & Cizauskas, 2021, species with the same body characteristics. However, close examination of genital structures, since the bodies are similar, suggests that *O. dorinha* sp. nov. is closer to *O. magali* sp. nov. a species from the same region. It is still difficult to establish relationships for *Ochyrocerca monica* sp. nov. and *O. rosinha* sp. nov. without a review of all Neotropical species. However, both fit into the *arietina* group, which includes those species whose males have a palp with an entire cymbium and without a retrolateral apophysis (Brescovit et al. 2018).

All species described in this work have morphological characteristics related to the subterranean habitat (Romero 2009), such as body depigmentation. However, we believe that only *O. rosinha* sp. nov. and *O. dorinha* sp. nov. have specializations (ocular



**Figure 16.** Lapa do Grotão cave, type locality of *Ochyrocera rosinha* sp. nov. Photos: Ataliba Coelho.

reduction or anophthalmia and elongated appendages) that indicate restriction to this type of environment (troglobites).

The distribution of *Ochyrocera dorinha* sp. nov. is similar to the *Tisentnops mineiro* Brescovit & Sánchez-Ruiz, 2016, another troglobite spider located in ferruginous



caves of the Quadrilátero Ferrífero (Brescovit & Sánchez-Ruiz 2016), although it is less abundant. Both species are distributed in caves in the areas of mining interest (Figs. 14, 15D) in the state of Minas Gerais, and lack studies aimed at the conservation of their populations.

*Ochyrocera rosinha* sp. nov. is not in an area of risk or threatened with extinction, and its population is restricted mainly to the caves of the Lapa do Grotão system (Fig. 16). This cave system is in a preserved environment due to legal protection by federal decree in Brazil since it is a large cave with rare troglobite species (Brasil 2008).

Although caves in iron formations are not large and extensive, they have been shown to be remarkably important in terms of animal life adapted to the subterranean environment (Ferreira et al. 2014). Spiders are very diverse in ferruginous systems in Brazil, and representatives of the genus *Ochyrocera* are, in addition to being diverse, specialized for life in this environment.

## Acknowledgments

We would like to thank to Beatriz Mauricio, microscope technician from Centro de Microscopia Eletrônica at the Instituto Butantan, for the SEM images; Coleção de Invertebrados Subterrâneos da Universidade Federal de Lavras (UFLA) for lending material; and Ataliba Coelho for the photos of Lapa do Grotão. This work was supported by Vale S.A., Organização de Apoio à Pesquisa da Biodiversidade (OAPBio), Conselho Nacional de Desenvolvimento Científico e Tecnológico CNPq (ADB grant PQ 303903/2019-8) and Fundação Butantan (ADB n° 001.0708.000636/2018). Erik R. Wild reviewed the English language. The authors are very grateful to the editor Martina Pavlek, and Nadine Dupérré, Pedro S. Castanheira and an anonymous reviewer for their careful reading of the manuscript.

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